A SAMPLE HANDLING, ENCAPSULATION, AND CONTAINERIZATION SUBSYSTEM FOR MARS SAMPLE CACHING MISSIONS

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ABSTRACT

Future Mars sample caching missions would require technology to acquire, encapsulate, and cache core samples into a container capable of being delivered back to Earth. The Mars Exploration Program Analysis Group (MEPAG) has highlighted the importance of collecting samples on Mars for Earth return, and current concepts for the Mars Astrobiology Explorer-Cacher (MAX-C) mission baseline a sample caching system. Numerous system architectures were investigated to cache samples, including the previous Mars 03'-05' mission concept utilizing a body-mounted corer and ring of individual sample tubes. The Integrated Mars Sample Acquisition and Handling (IMSAH) system utilizes an arm-mounted Sample Acquisition Tool (SAT) and Sample Handling, Encapsulation, and Containerization (SHEC) subsystem to perform the sample acquisition and caching functions.

The SHEC system consists of a canister carousel, handling arm, and bit carousel. The canister carousel rotates a canister containing sample tubes sized for 1 cm diameter by 5 cm long cores, spare sample tubes, and sample tube plugs. The bit carousel rotates a platform of four coring bit assemblies (CBAs), which can be attached and detached to a SAT. During sample acquisition, the handling arm removes an empty sample tube from the sample canister and places it into a CBA. The SAT attaches and removes the CBA, cores a sample, and places and releases the CBA back into the SHEC. The handling arm removes the filled sample tube from the CBA, seals it with a plug, and places it back into the cache canister.

The current SHEC prototype configuration contains one sample container with 19 sample tubes, 2 spare tubes, and 4 CBAs. Flexibility in the design allows expansion of the SHEC system to also include additional canisters, spare sample tubes, and specialized tools compatible with the SAT. A prototype of the SHEC subsystem was built and tested at the Jet Propulsion Laboratory, and a TRL 4 level design is currently in development.